

ABDOMINAL PUNCTURE IN THE DIAGNOSIS OF ACUTE INTRAPERITONEAL DISEASE*

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DESPITE the vast numbers of operations that are performed for acute intraperitoneal disease, improved methods in the pre-operative diagnosis have not been evolved in recent years. As a result, the indications for or against operation are not always clear, the history and the usual physical examination not infrequently fail to establish a positive diagnosis, and the choice for or against an exploratory laparotomy may rest on relatively scant evidence. The exact proportion of cases in which the diagnosis remains in doubt cannot be stated, but in our own experience we would place it between five and fifteen per cent. In some of the cases in this group, the subsequent course proved that laparotomy had not been indicated. In other cases, non-intervention proved to be equally incorrect. Were it solely a matter of scientific imperfection in diagnosis, this situation could be termed merely unsatisfactory; unfortunately, however, errors in diagnosis and indication have occasionally led to unnecessary complications and even to death in some instances. Any safe method that can aid in the diagnosis of acute intraperitoneal disease should therefore be welcome. From our experience we are convinced that abdominal puncture is a safe procedure that is often of invaluable aid in the diagnosis of acute intra-abdominal lesions.

The use that has already been made of abdominal puncture in acute abdominal disease can be briefly sketched for the literature contains only scattered references to the method. In 1906, Solomon¹ devised an ingenious but rather complicated apparatus that he recommended for abdominal puncture. It consists of a needle within a trocar, through which a ureteral catheter is passed into the peritoneal cavity. Solomon described a few cases in which the procedure appeared to be of value. Abdominal puncture to determine an appendiceal abscess is mentioned by Sahli² in his *Manual of Diagnosis*. In 1912, Panichi³ reported the results in two cases, together with an examination of the aspirated fluid and autopsy records. At a meeting of the New York Surgical Society a number of years ago, Lilienthal suggested the use of exploratory puncture for the diagnosis of gonococcus or pneumococcus peritonitis. Denzer⁴ devised a trocar with capillary tube for the study of peritoneal fluids in infants, and encountered a few instances

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in which peritonitis was unexpectedly disclosed by the use of the instrument. He believed that fluid could be more readily obtained by a capillary tube than by ordinary aspiration. The conclusion that can be drawn from the literature is that abdominal puncture has proved of some diagnostic value in a few scattered cases.

About five years ago we began to use abdominal puncture for diagnosis. Our first efforts were in the direction of establishing a satisfactory technic and of determining the frequency with which fluid would be found on pre-operative puncture when it was proved to be present at operation. Thus, during a short period, abdominal puncture was employed as a routine in most cases of acute peritoneal conditions that came to operation. The punctures were performed under anæsthesia just prior to laparotomy. In the later series of cases, abdominal aspiration was used in those instances in which the diagnosis was uncertain or could not be established by the usual methods of physical examination.

The subject will be taken up as follows: (1) The technic of abdominal puncture. (2) The safety of the method. (3) The significance of negative punctures. (4) Contra-indications. (5) Value of abdominal puncture in diagnosis and prognosis, and in the indications for and contra-indications to operation.

Technic.—The method we employ consists of the use of a lumbar puncture needle to which a ten or twenty c.c. syringe fits accurately. The usual preparation of the skin of the abdominal wall is made. Either freezing of the skin with ethyl chloride or anæsthetization of the proposed tract of the needle with novocain is practiced. A small incision in the skin is made for two reasons: first, to avoid carrying bits of skin into the track of the needle, and, secondly, to preserve the delicacy of touch when the needle is introduced. The usual site of election is a point at or below the level of the umbilicus to the right or left of the median line. We have generally punctured through the rectus muscle near its outer border, but puncture can be made lateral to the muscle. The site of puncture can often be placed in the line of the probable laparotomy incision. Of course aspiration will not be performed over the situation of a palpable or questionable mass. Thus if puncture is to be employed in a case of suspected appendicitis abscess with peritonitis, it should be done in the left lower quadrant. After the skin incision, the lumbar puncture needle with stylet in place is introduced perpendicularly with slow even pressure. In puncturing through the rectus muscle the resistance of the anterior sheath is felt. Passing through the muscle, a similar resistance of the posterior sheath is encountered, and then the needle enters the peritoneal cavity. The stylet is withdrawn and the syringe attached. While suction is being maintained, the needle is pointed in various directions. If no fluid is immediately found, the vacuum in the syringe should be maintained for a time, for we have withdrawn fluid in some instances only after an interval of several seconds. The latter is particularly true when the amount of intra-peritoneal fluid is small. It is of practical importance to note that fluid is

more frequently encountered just beneath the anterior parietal peritoneum than in the depths of the abdominal cavity. Therefore suction should be especially maintained as the needle is withdrawn, in cases in which fluid has not been encountered up to that time. In some instances only a drop of fluid may be withdrawn and may be missed unless sought for in the lumen of the needle or on the surface of the plunger. A dry tap should not be assumed merely because fluid is not at once evident. We wish to emphasize the fact that we have upon a number of occasions obtained the necessary information for a positive diagnosis from a single drop of fluid.

Safety of the Method.—Theoretically, a possibility of injury to a loop of gut exists. We are convinced, however, that this is only theoretical in acute abdominal conditions. In the first place this accident has not been seen by us in an experience of more than a hundred cases. The majority of these were subjected to operation and evidence of trauma to the intestine has never been noted. The subsequent course of those not operated upon in no way suggested a visceral injury. Secondly, the use of abdominal puncture for pneumoperitoneum has demonstrated the absence of danger in introducing the needle.⁶ Finally, we have attempted to puncture loops of exposed intestine with a lumbar puncture needle and have been unable to do so unless the gut is held fixed. There may possibly be some danger in the use of a very fine needle, but there is every reason to believe that none exists with the ordinary small-sized lumbar puncture needle. We wish to emphasize here, however, that abdominal puncture is not safe in subacute or chronic intra-abdominal lesions, in which a loop of intestine may be fixed.

Whether the following history can properly be included as an example of injury to a fixed loop of gut is doubtful, but it is reported for the sake of completeness. A middle-aged man was admitted to the hospital with a ten-hour history of generalized abdominal pain. With the onset of pain, a left inguinal hernia of long standing became irreducible. Obstruction, however, was not complete. Because of the very marked generalized abdominal rigidity a peritonitis was suspected and abdominal puncture was done in the left lower quadrant. This proved negative. At operation a sliding hernia of the sigmoid was found, surrounded by purulent exudate. The free peritoneal cavity was not entered. A virulent post-operative gas gangrene of the wound and abdominal wall developed. The patient died three days after operation. At the post-mortem examination there was found, in addition to the gas gangrene of the abdominal wall, adherent gangrenous loops of small intestines and sigmoid, with a perforation and peritonitis. It is probable that this was the primary condition and that the irreducible hernia was due to increased intra-abdominal tension. The perforation was not at the site of abdominal puncture. The case is presented because it is the only one in which there existed any possible relation between abdominal puncture and an intestinal lesion.

The Significance of Negative Abdominal Puncture.—Before discussing the value of abdominal puncture in diagnosis; the proportion of negative

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punctures in the presence of fluid should be stated. There were negative punctures in the presence of fluid demonstrable at operation in four cases in our series. Therefore, with the technic we employ, *a negative puncture does not exclude the presence of fluid*. Thus in a case in which a peritonitis is suspected a negative puncture in no way justifies the elimination of that diagnosis. On the other hand, a negative puncture in cases of peritonitis in which the pneumococcus or gonococcus is suspected, may be of some value. In such instances, with the diagnosis in doubt, operation would probably be performed, whereas it would not be carried out if the puncture were positive and revealed either of these organisms. There have been some instances in which a negative puncture has supported the clinical impression of absence of an intraperitoneal lesion, and to this extent has been of value. For example, in a recent case the wheel of a wagon ran over the left lower chest of a boy. He was in moderate shock, the pulse-rate was elevated, the upper abdominal wall tense. There was not enough evidence to warrant the diagnosis of an intra-abdominal lesion (rupture of the spleen), and the case was considered one for observation unless the abdominal puncture was positive. The puncture was negative, and the further course demonstrated that no gross intraperitoneal lesion had existed. In general, however, a negative puncture is of no diagnostic significance. We cannot stress too strongly the necessity for a clear appreciation of the meaning of a negative puncture. *If in any given case the decision has been reached that operation is indicated, whether for a traumatic or an inflammatory intraperitoneal lesion, operation should be proceeded with absolutely regardless of a negative puncture.* It is a positive puncture under such circumstances that might lead to non-operative treatment, never a negative puncture. Unless this viewpoint is clearly kept in mind, operation might be withheld in cases in which it is indicated.

Contra-indications to Abdominal Puncture.—The first obvious contra-indication to abdominal puncture exists when the diagnosis or the clinical indication is sufficiently clear without it. The only other contra-indication has already been pointed out, namely, a chronic or subacute intraperitoneal lesion (neoplasm, tuberculosis or other chronic inflammation) that may fix a loop of intestine. When a mass is present in an acute peritoneal infection, puncture should not be performed in that region because of the danger of injuring a fixed loop of intestine.

The diagnostic value of abdominal puncture consists, first, in the demonstration of the existence of fluid, whether blood, serous effusion, or pus, and, secondly, in making possible examination of the fluid that is withdrawn. Other than blood or bloody fluid obtained in traumatic cases, both the macro- and microscopic characteristics must be evaluated. For example, it is the organism found in the microscopic examination of spreads of the aspirated fluid that establishes the diagnosis of a pneumococcus or a streptococcus peritonitis. In a case of rupture of the bladder the urinous odor of the fluid obtained by puncture gave the clue. In acute pancreatitis we have found that the fluid sometimes has a typical beef juice color and oily appearance.

In four cases of verified pancreatitis the fluid was characterized by a high content of polymorphonuclear leucocytes (85 to 90 per cent.) and at the same time an absence of bacteria in the spreads. A yellow fluid with sour odor aided in establishing the diagnosis of a perforated gastric ulcer in one instance. Enough has been said to indicate that the diagnostic value of a positive puncture in general depends at least as much upon a study of the fluid as upon merely obtaining fluid.

The proven diagnostic value of the method in our hands is best illustrated by taking up the different groups of cases in which it has been employed. Albeit convenient, this is a somewhat artificial manner of treating the subject, because in not a few instances the group into which a case fell was only determined by the abdominal puncture.

The *traumatic group* of cases will be first considered, and some illustrative cases presented. Abdominal puncture was of diagnostic value in a number of instances. In a case of stab wound of the left flank, seen shortly after the accident, there was very slight evidence of an intraperitoneal lesion. Blood was obtained by abdominal puncture and this finding was the determining factor in the decision to operate. A penetrating wound of the descending colon was found. Of four cases of rupture of the spleen, operation in one was performed chiefly because blood was withdrawn on puncture. This patient was seen within two hours of the accident and presented only vague clinical evidence of an intra-abdominal lesion at the time. In another case the clinical picture was interpreted as one of an inflammatory focus in the left upper abdomen:

The boy entered the hospital two days after having fallen against the curb, striking his left lower chest. His temperature was 102.6, there was rigidity and a rebound sign throughout the abdomen, most marked in the left upper quadrant. The white blood count was 22,000, with a differential count of 84 per cent. of polymorphonuclear cells. A rupture of the spleen was not considered in the diagnosis. Puncture of the general peritoneal cavity was negative, but aspiration of the left subphrenic region disclosed blood. A rupture of the spleen with perisplenic hæmatoma was found at operation, no blood being present in the free peritoneal cavity.

In a case of injury to the right lower chest with very questionable evidence of a lesion of the liver, blood found at puncture led to an exploratory laparotomy. A superficial tear of the liver surface was found, from which the bleeding had ceased at the time of operation. This is the only case in which a positive abdominal puncture, although verified at operation, led to an unnecessary laparotomy.

In the following case the evidence favored an intrathoracic lesion:

Bullet wound with entrance just below cardiac apex, X-ray showing the bullet lodged high up in right lobe of liver or in lower lobe of right lung. The opinion of the radiologist was that the peritoneal cavity was not penetrated. The abdominal wall was rigid, however, and an intraperitoneal lesion was suspected. There was blood on abdominal puncture; at operation, penetration of the diaphragm and liver and a large amount of blood in the peritoneal cavity were encountered.

Another interesting example was a case of fracture of the pelvis in a patient with peritonic manifestations. Catheterization disclosed urine free

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from blood. The diagnosis therefore was a probable retroperitoneal hemorrhage. However, fluid with a urinous odor was obtained by abdominal puncture. Therefore operation was performed despite the negative urine found by catheterization. An intraperitoneal rupture of the bladder was found at operation, the tear being at the fundus.

Turning now to the group of *peritonitis* cases, there was a surprising number of instances in which positive abdominal puncture was of decisive value not only in the diagnosis, but also in the prognosis. The first group is that of *pneumococcus peritonitis*, all in children. The value of puncture in the diagnosis of this disease is so evident, that we need only refer briefly to it here. There have been ten or more cases under our observation in the past five years. In some the diagnosis was probable without puncture, in others, doubtful. In two or possibly three, the diagnosis was acute appendicitis, and in these the result of puncture led to the correct treatment—namely, to withhold operation. It would be out of place to discuss here the surgery of pneumococcus peritonitis, but an illustrative case will demonstrate the value of puncture in the diagnosis and in the indication for treatment: A girl presented the picture of a probable pneumococcus peritonitis. Abdominal aspiration revealed pus containing the organisms. Under observation the process localized, a large pneumococcus abscess was drained, and the patient recovered.

The next group of cases is that of *streptococcus peritonitis*. There were several cases in this group, chiefly in children, in which the diagnosis of the nature of the peritonitis was in doubt until cleared up by abdominal puncture. It is safe to say that nearly all of them would have been subjected to an unnecessary laparotomy with a tentative diagnosis of acute appendicitis with peritonitis if puncture had not been employed. It is, of course, possible for a pure streptococcus peritonitis to be secondary to an infective focus that is remediable by operation, but in the gravely ill, septic patients who have come under our observation and have died, autopsy has invariably demonstrated that the streptococcus peritonitis was part of a general sepsis and was not derived from an intraperitoneal pus focus. In two striking cases the saving of life can be largely ascribed to the disclosure of a streptococcus peritonitis by puncture and the consequent withholding of operation.

A child was admitted in a septic state, with an acutely inflamed throat and the clinical picture of a peritonitis. The admission diagnosis was acute appendicitis. It was evident that even a simple laparotomy would be very poorly withstood by the child in its desperately toxic state. The turbid fluid obtained by abdominal puncture revealed chains of streptococci in the stained spreads. Conservative treatment was instituted. For several days the septic state continued, the blood culture was positive, but the abdominal manifestations gradually cleared up. A pneumonia developed, followed by an empyema that was drained, and the child recovered.

The second case was perhaps more remarkable:

A girl of ten presented the clinical picture of an acute, virulent peritonitis, in which the diagnosis of acute appendicitis had been made. The abdominal condition had apparently followed a sore throat. Her condition was desperate, and the only justification

for a laparotomy would have been a reasonable assurance of the existence of an appendicitis. By abdominal puncture, cloudy fluid containing streptococci was withdrawn. Treatment of the septic state was instituted. Blood culture proved positive. After several days, drainage of a localized intraperitoneal collection of pus was performed, metastatic abscesses in various parts of the body—tibia, ankle-joint, pleura, etc.—were drained, and the patient recovered.

The importance we attach to the finding of streptococci alone in the smear of aspirated fluid, and the contra-indication to operation in doubtful cases, based on such a finding, is supported by a study of the culture of peritoneal fluids. Through the courtesy of Dr. F. S. Mandlebaum we looked up the records of such cultures over a period of three years at Mount Sinai Hospital, during which time there were more than 200 that were studied. Just twice was a pure culture of streptococcus obtained in acute appendicitis. These may not be the only instances in which the streptococcus was the sole organism, for cultures are not taken at all operations. From this report and from our own experiences, however, our conclusion is that a case of appendicitis clinically so obscure as to call for puncture and in which streptococci alone are to be found in spreads of the fluid obtained must be a very rare combination. As in any other diagnostic procedure, abdominal puncture is but part of the composite picture, but where it is called upon as an aid, the finding of streptococci has in our hands been a signal to withhold operation. This conclusion has been supported by our results, in which non-operative treatment, in the early stages of a streptococcus peritonitis at any rate, has unquestionably resulted in the saving of life in several instances.

Turning to a group of seven cases of *acute pancreatitis*, abdominal puncture proved of great value in all but one. These patients came under observation with the clinical picture of acute or subacute intestinal obstruction with some signs pointing to a peritonitis. Although acute pancreatitis was suspected in some, the disclosure of fluid having the characteristics that have already been mentioned clinched the diagnosis. In one patient who would have ill withstood an exploratory laparotomy, the result of abdominal puncture was of decisive aid in the decision to defer operation.

This was a thick-set man, with a greatly distended abdomen and a short history of intestinal obstruction. His circulation was collapsed, his skin cyanotic. Although the diagnosis of an acute pancreatitis was entertained, an acute cholecystitis or an intestinal obstruction could not be excluded. Abdominal puncture disclosed fluid resembling beef juice containing 87 per cent. polymorphonuclear leucocytes, but no bacteria. Under conservative treatment the fulminating abdominal manifestations gradually subsided; fullness and oedema developed in the left lateral abdominal region. On the eighth day after admission an extraperitoneal incision was made and a peri-pancreatic abscess, with a cavity lined by necrotic fat and containing sloughs of pancreas, was drained. The patient made a slow recovery, with discharge of pancreatic sloughs from the wound.

The one case of proven acute pancreatitis in which abdominal puncture did not reveal the typical fluid should be mentioned, although the existence of a non-bacterial peritonitis was demonstrated. A stout, elderly woman came under observation with the picture of an intestinal obstruction, and pneumonia of both lower lobes (verified by X-ray). In the diagnosis, acute cholecystitis and acute pancreatitis were considered. Puncture on the right side of the abdomen was negative. The next day puncture to the left

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of the umbilicus revealed thin pus containing 95 per cent. polymorphonuclear leucocytes, but no bacteria in the spreads. The fluid did not present the appearance we consider typical of the peritoneal exudate in acute pancreatitis. At operation, under local anæsthesia, an incision in the right upper quadrant was made, fat necrosis characteristic of pancreatitis was found, but no purulent fluid was encountered. A cholecystostomy was performed, the left side of the abdominal cavity was not explored. It must be assumed that the purulent fluid was encapsulated on the left side; the subsequent course of the case indicated a spontaneous disappearance of this exudate.

Unless the peritoneal exudate is the oily, beef juice like fluid typical of cases of pancreatitis, all that can be said of the finding of preponderating polymorphonuclear cells and no bacteria in an abdominal puncture fluid, is that the patient is suffering from an aseptic peritonitis. If this fits in with a clinical picture of pancreatitis the diagnosis is justified. However, in the following case, we were misled in our interpretation.

A woman suffering from diabetes presented the clinical picture of an acute incomplete intestinal obstruction with pain and tenderness over the left lateral abdominal region. During several days' observation the conclusion was reached that the lesion was an acute pancreatitis. Abdominal puncture disclosed cloudy fluid containing 80 per cent. polymorphonuclears but no bacteria. The symptoms persisted and at operation there was found a carcinoma of the colon with incomplete intestinal obstruction and secondary peritoneal exudate.

Clinically, the above instances are a borderline between the group in which the diagnosis of a peritonitis is clear and the group in which that diagnosis cannot justifiably be made by the usual physical examination. In the past five years we have seen several cases belonging to the latter group. It is noteworthy that in these cases abdominal puncture was of decisive value. Two striking instances will serve as illustrations:

In the first a colored woman was admitted with a history of frequent vomiting and high fever. She was delirious and it was impossible to make a satisfactory physical examination. Abdominal puncture disclosed considerable cloudy fluid containing streptococci. Operation was not performed. The septic state rapidly grew worse and the patient died the same day. The autopsy revealed a phlegmonous gastritis and a generalized streptococcus peritonitis.

The second case was a man, fifty-seven years old, with a history of acute abdominal pain, preceded by sore throat, and the presence of pronounced icterus. The provisional diagnosis was acute pancreatitis, although the history of sore throat raised the question of a metastatic peritonitis. The abdominal puncture fluid contained polymorphonuclear cells and streptococci. The patient died of streptococcus peritonitis. At autopsy the source of the infection was not found.

A diagnostic value of abdominal puncture to which we have not as yet referred, exists in some cases in which the diagnosis of a peritonitis can be readily made and the indications for operation are clear, but in which the nature of the lesion is obscure. In a number of instances the character of the fluid obtained by aspiration has aided in clearing up the diagnosis and has thus enabled us properly to place the abdominal incision. As an example we may cite a case in which the diagnosis was acute appendicitis and spreading peritonitis. Abdominal puncture under anæsthesia disclosed fluid character-

istic of a perforated gastric ulcer; this was the lesion found upon opening the abdomen in the right upper quadrant.

Finally, there are many acute intraperitoneal lesions in which we have not had the opportunity to test the diagnostic value of abdominal puncture. It is logical to believe that in such conditions as perforations of hollow viscera (in which air might be obtained by puncture), ruptured ectopic gestation, or twisted ovarian cyst, abdominal puncture will prove of as much diagnostic value as in the intra-abdominal lesions in which we have employed the method.

SUMMARY

1. Exploratory abdominal puncture is a simple, safe, and valuable aid in the diagnosis of obscure acute intra-abdominal disease.
2. It serves to establish the diagnosis of a traumatic or inflammatory intraperitoneal lesion in some cases in which the diagnosis cannot otherwise be made.
3. In other instances abdominal puncture offers conclusive information as to the source and nature of a peritonitis, and thus aids directly in arriving at the therapeutic indication as well as the prognosis.
4. In the peritonitis group abdominal puncture is of especial value in establishing the diagnosis of the pneumococcus and streptococcus infections.
5. Abdominal puncture is contra-indicated in any subacute or chronic intra-abdominal disease in which a loop of intestine may be fixed.
6. A negative abdominal puncture does not exclude the presence of fluid and should therefore never be interpreted as a contra-indication to operation in suspected peritonitis or traumatic visceral lesions.
7. Abdominal puncture should be employed as an aid to diagnosis in every obscure acute intraperitoneal lesion for which operation may be indicated.

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